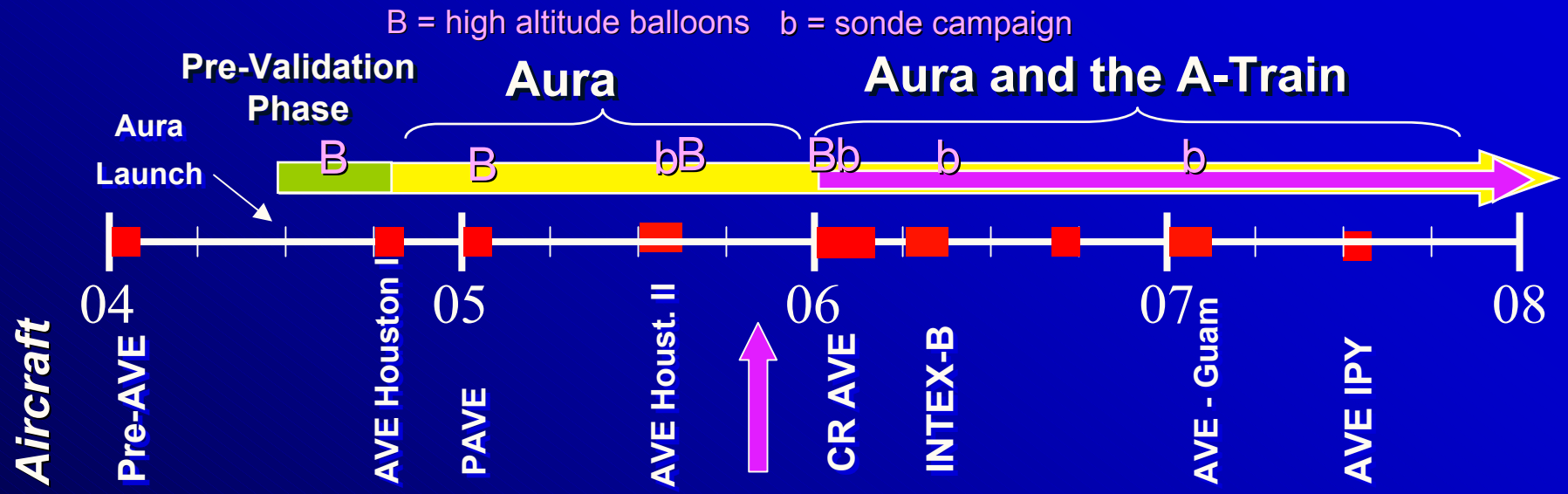
Aura Validation Program Status

Aura instruments produce 63 data products that need validation.

Validation activities up to 09/05 ~ 1 year after Aura activation:

- AVDC is up and running - heavy usage
- Validation workshop Sept. 05.
- Aircraft Field Campaigns
  - Two Houston WB-57 mini-campaigns
  - One polar DC-8 mini-campaign
  - UAV payload and plans moving forward
- Two high altitude instrumented balloon flights from Palestine, TX
- Two intensive H_2O and O_3 sonde campaigns in Costa Rica
- Additional sondes launched from traditional sites
- Numerous satellite intercomparisons
  - UARS HALOE
  - ACE
  - Envisat
  - Odin, SBUV, etc.

Aura Validation Campaign Timeline



Jan. 04	– pre-AVE- (Costa Rica)
Aug. 04	-- Ticosonde I (Costa Rica)
Oct. 04	-- Houston AVE I
Jan. 05	– PAVE
Jan. 05	-- Polar high altitude balloon launch (failed)
June 05	– Houston AVE II
July-Aug. 05	-- Ticosonde II campaign - Costa Rica
Sept. 05	-- Validation Workshop I
Sept. 05	-- High altitude balloon launch
Jan.-Feb. 06	– Costa Rica AVE (CR-AVE) (payload increased)
Jan. 06	-- Polar high altitude balloons (replaced failed launch)
Jan.-Feb. 06	--Ticosonde campaign - Costa Rica (added)
Mar.- Apr. 06	*– INTEX-B (Houston, Anchorage, Hawaii) (lidars added)*
April 06	-- Sodänkyla High latitude ozone column intercomparison campaign
Jan. 07	– AVE/TC4 winter (Guam) + sonde campaign
Aug. 07	-- AVE (IPY) - still under discussion

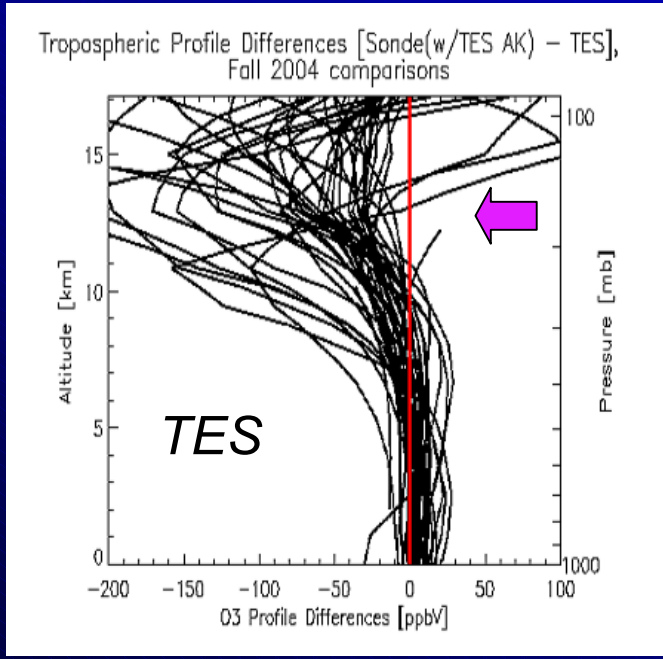
Completed activities
Planned activities
Augmentations

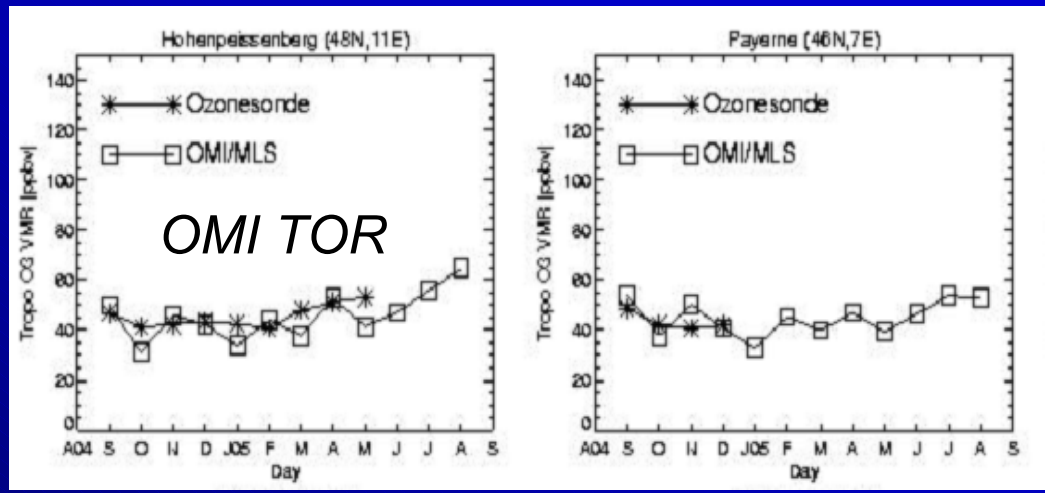
Summary of Relevant Sept. Validation Workshop Results - where we are now

- Tropospheric ozone profiles
- Temperature
- Water
- NO_2, HCHO
- CO

Tropospheric Ozone Profiles

- Most validation is associated with TES (profiles) and OMI TOR





TOR = Total ozone residual

Ozone Profiles

-- High spatial correlation between TES retrieved and GEOS-Chem simulated tropospheric ozone.

– Largest difference in the upper troposphere: systematic high bias in TES

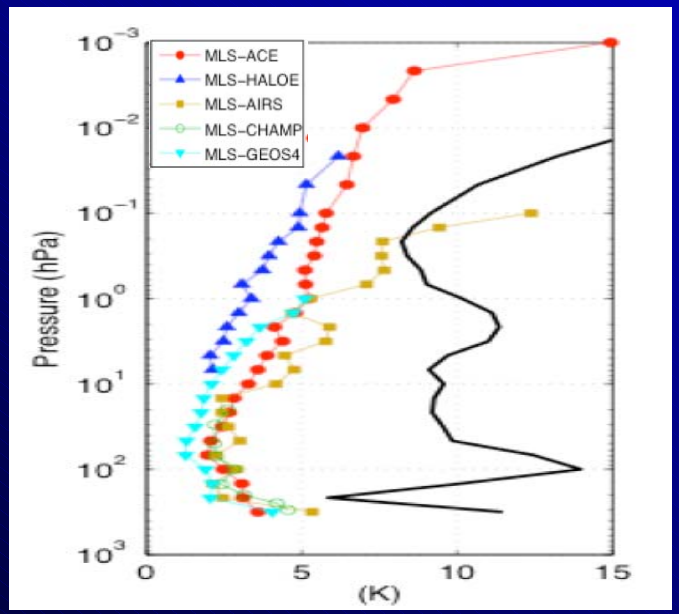
– New TES calibration scheme will improve the comparison in the upper troposphere with no significant impact in the lower troposphere.

TOR - (OMI-MLS) Good early results, need more MLS comparisons at 215 mb needed.

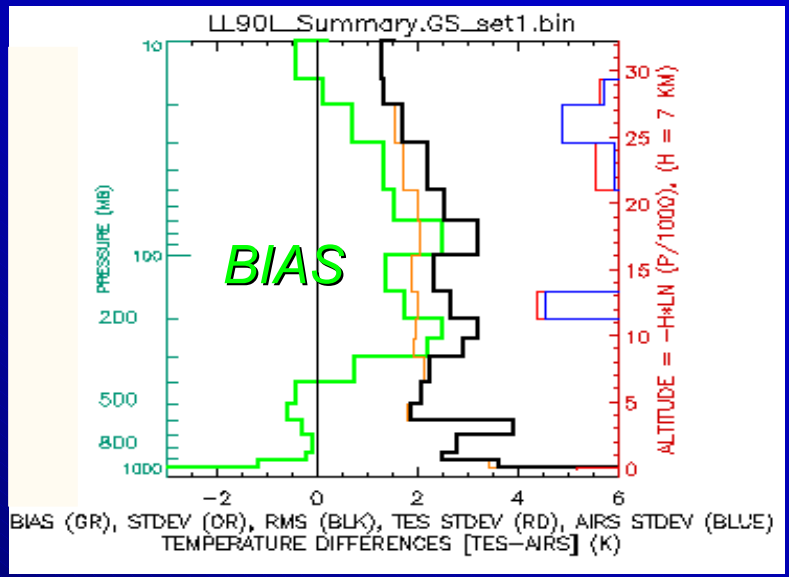
Temperature

- MLS and TES are main focus (HIRDLS not ready)
- Good leverage off AIRS validation

MLS



TES

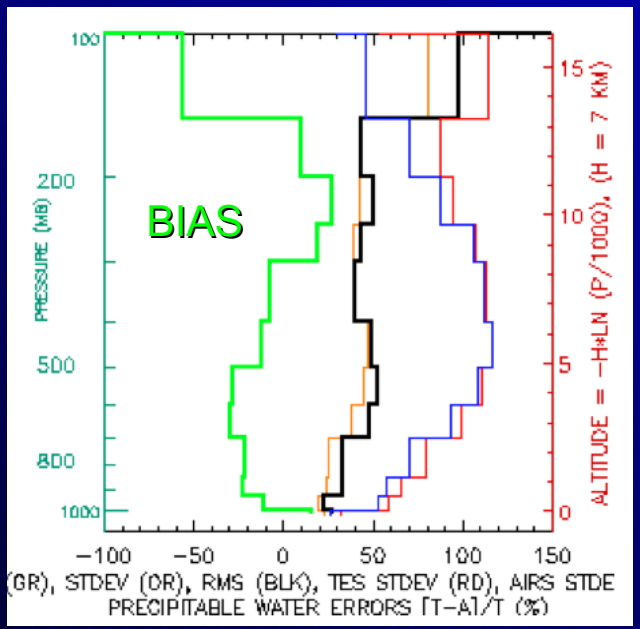


- TES UT warm bias and LT cold bias are due to known calibration problems which will be fixed in next version (Version 9).
- MLS biases at upper and lower range - needs to look at additional lines beside “core” for UT/LS and mesosphere

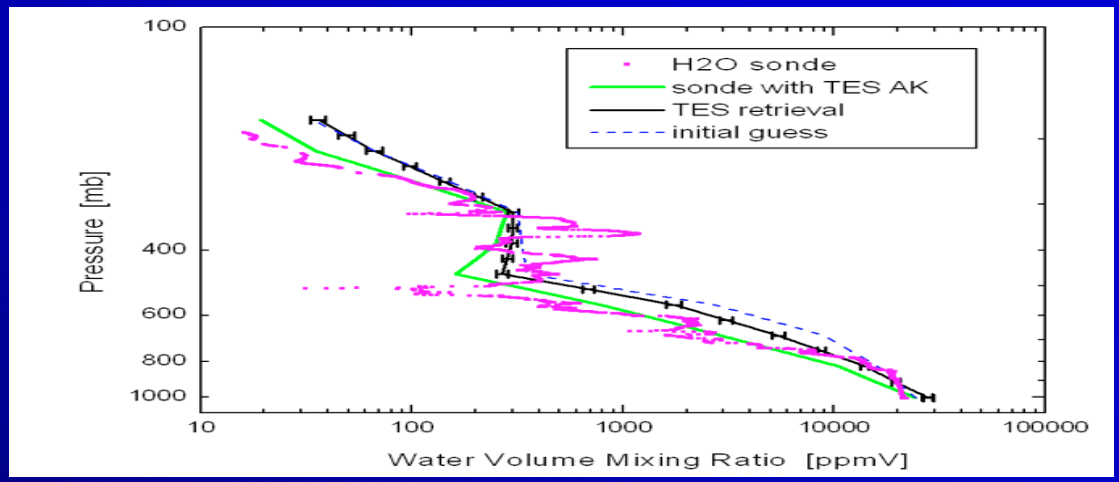
TES Water

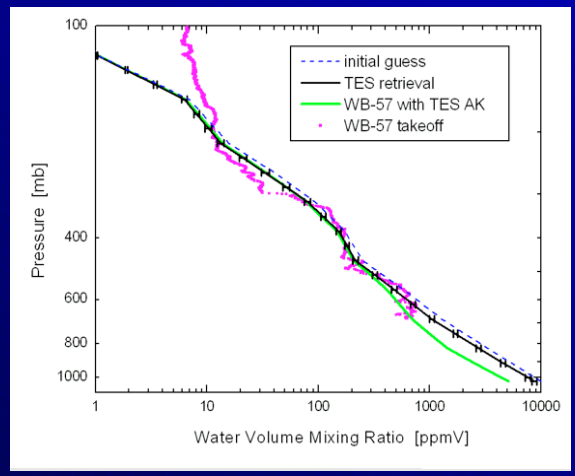
Good leverage off AIRS validation

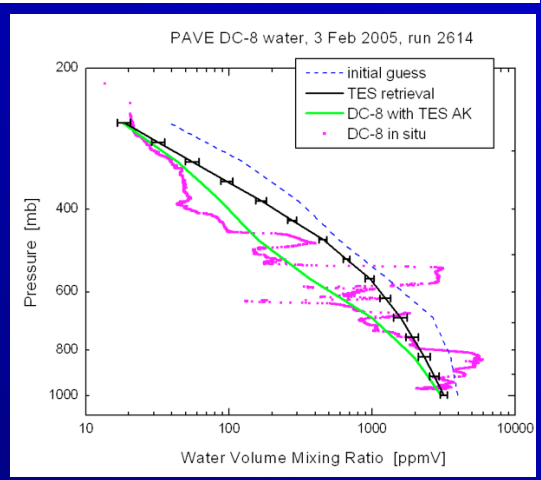
TES vs AIRS



TES vs Sonde and Aircraft

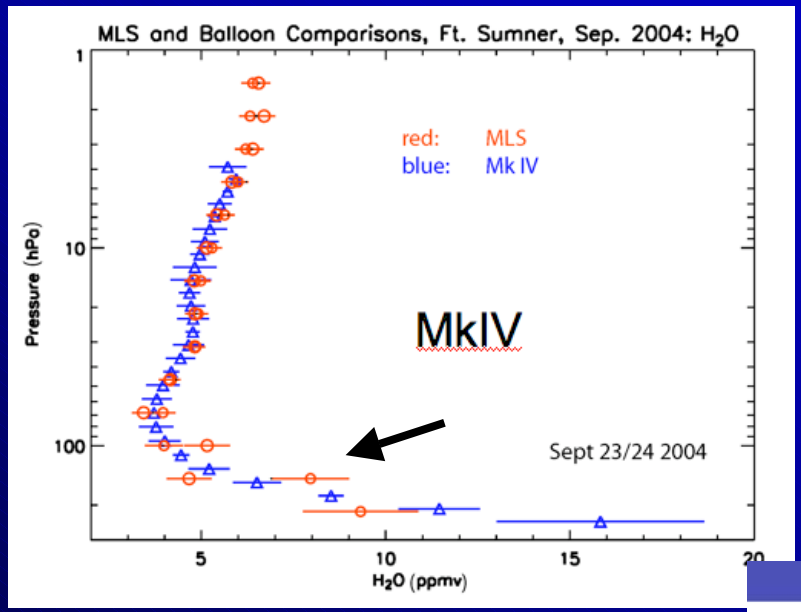






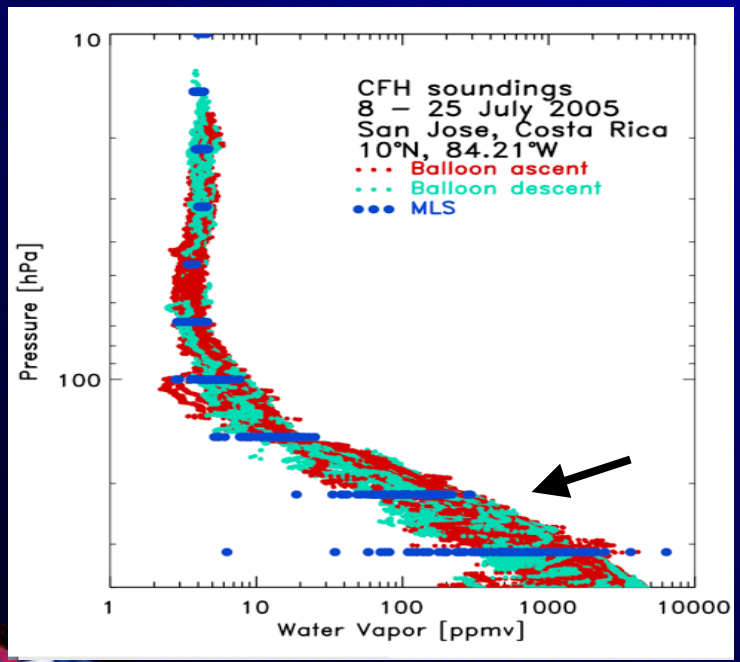
- TES H_2O compares to within 20% of AIRS & sondes
- Improvements will occur with change in calibration (Version 9)

MLS Water



MLS vs Balloon

MLS vs Satellite



Summary of Satellite Intercomparisons

Pressure,	Vertical Resolution,	"True" Precision,	Estimated Precision	Estimated Accuracy Difference	Difference	Difference
hPa	km	ppmv	ppmv	HALOE	SAGEII	ACE
0.1	7	0.3	0.8	+10%		-10%
1	5	0.1	0.3	+5%	-15%	-3%
10	4	0.1	0.3	+5%	+10%	-1%
100	3	0.8	0.5	+15%	+5%	-5%

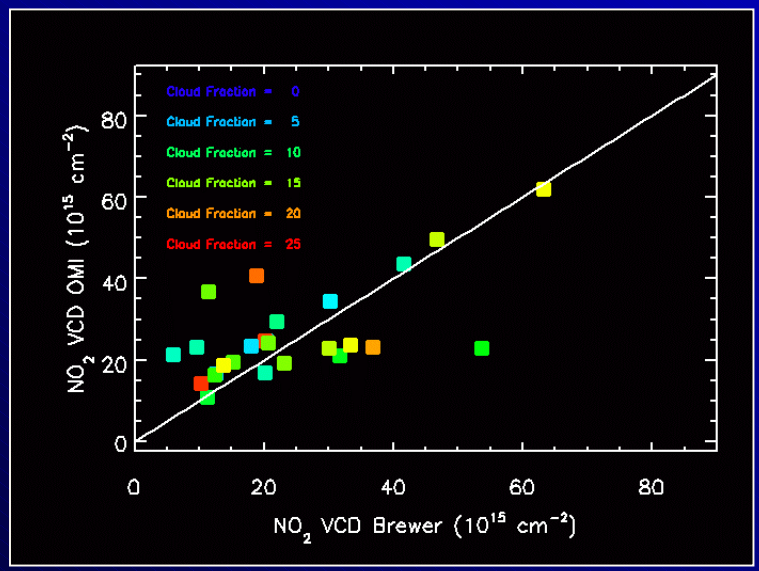
- More Upper Trop validation is needed
- Known algorithm issues in the upper trop
- Need to extend vertical range

Radicals

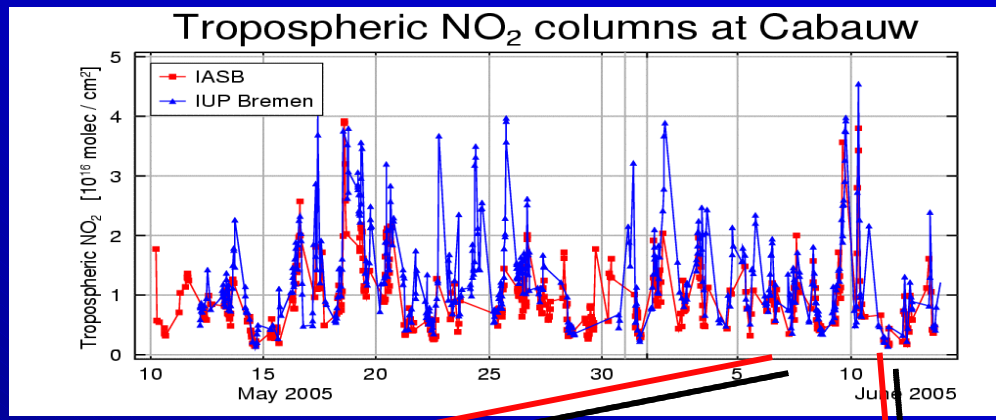
Species	Column	Profile	Validation	Status
NO_2	OMI		Ground based column, Satellite	Good start, need lower trop. profiles
HCHO	OMI		Aircraft, Satellite	Still analyzing PAVE data
BrO	OMI	MLS	Balloon, aircraft	Models
OClO	OMI		Balloon, aircraft	Product not available yet
OH		MLS	Balloon & ground based column	Balloon profiles and ground based comparisons
HO_2		MLS	Balloon	No validation yet

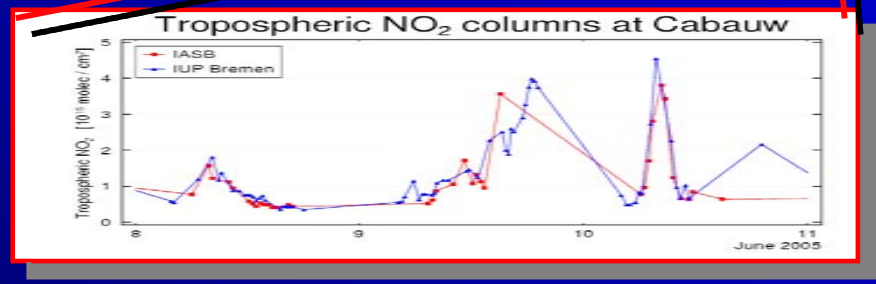
OMI NO_2

Compared to Brewer



Max DOAS Cabauw, Netherlands (51°N)





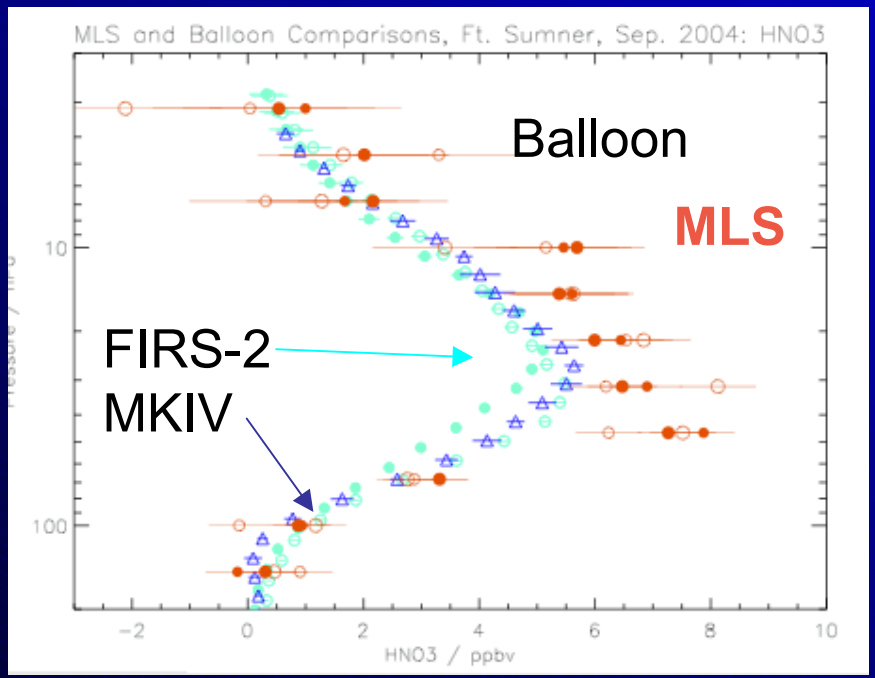
More observations of NO_2 profiles are needed

NO_2 & HCOH:

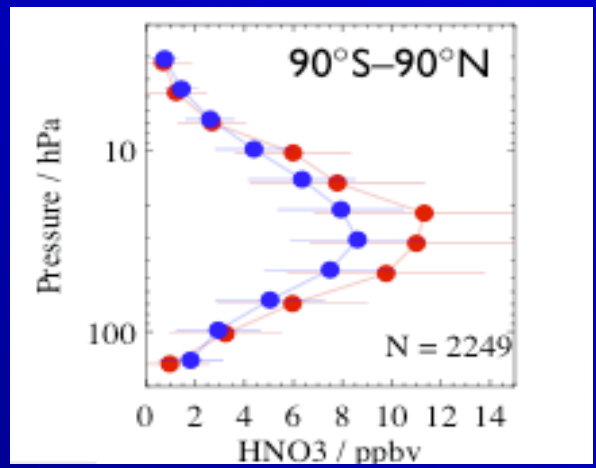
— compare DC-8 profiles, OMI columns

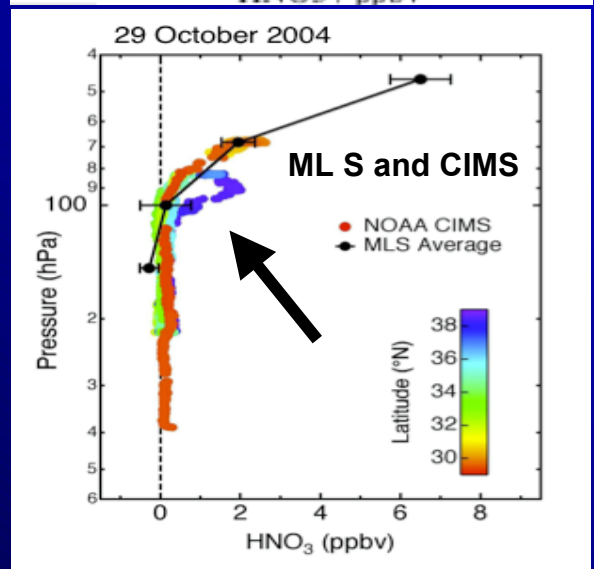
HNO_3

- MLS shows relatively high observations near peak



MLS and ACE

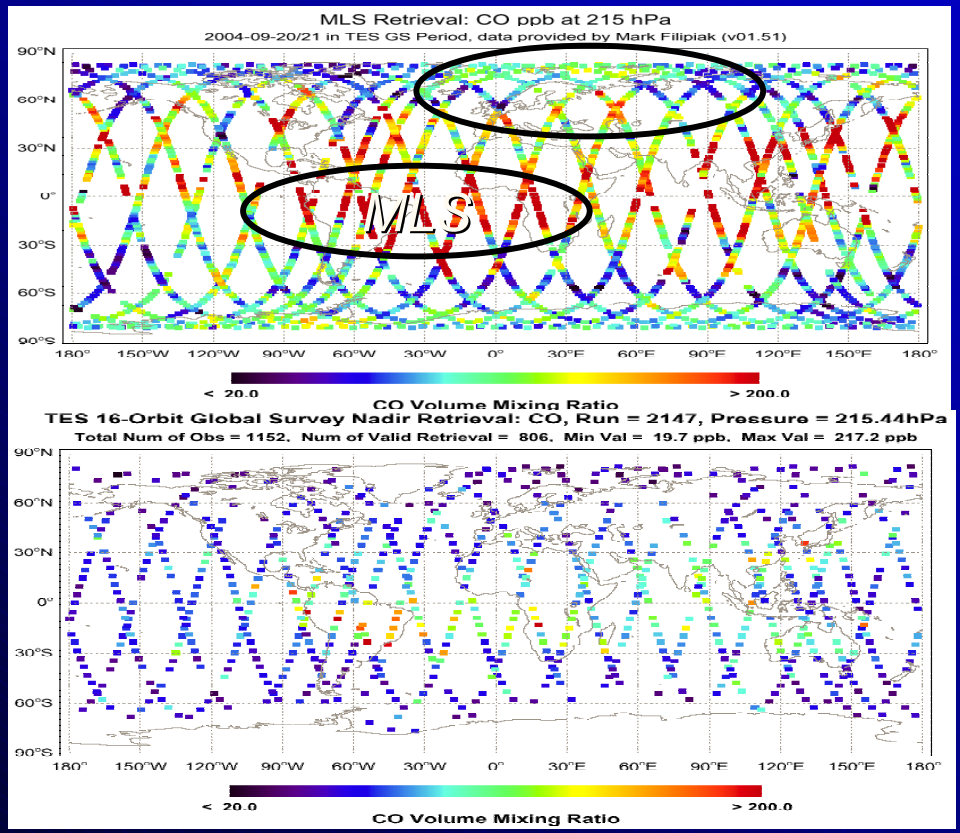


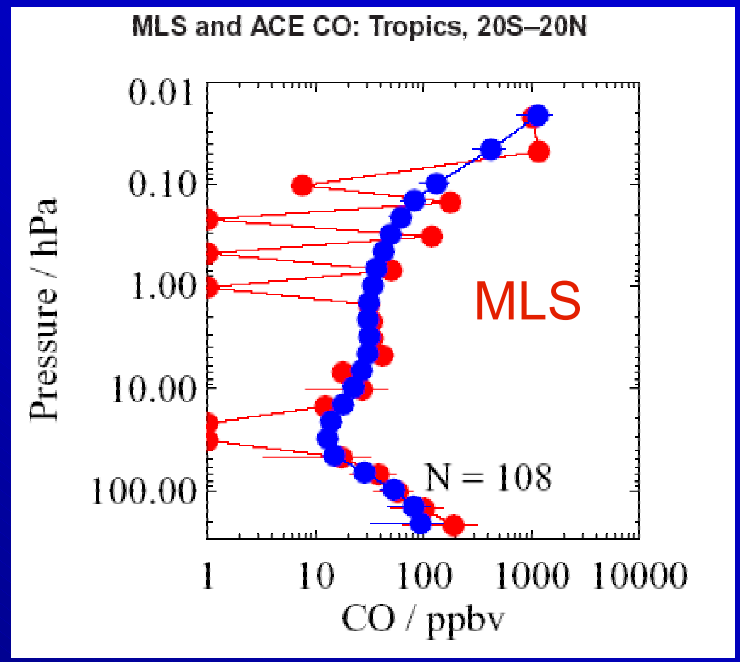


- Discrepancy at peak may be due to microwave (or IR) spectroscopy errors.
- TES will begin work on HNO_3 limb soon

CO

- MLS and TES





Worst case, MLS

Major artifacts exist in MLS data (will be addressed in V2.0):

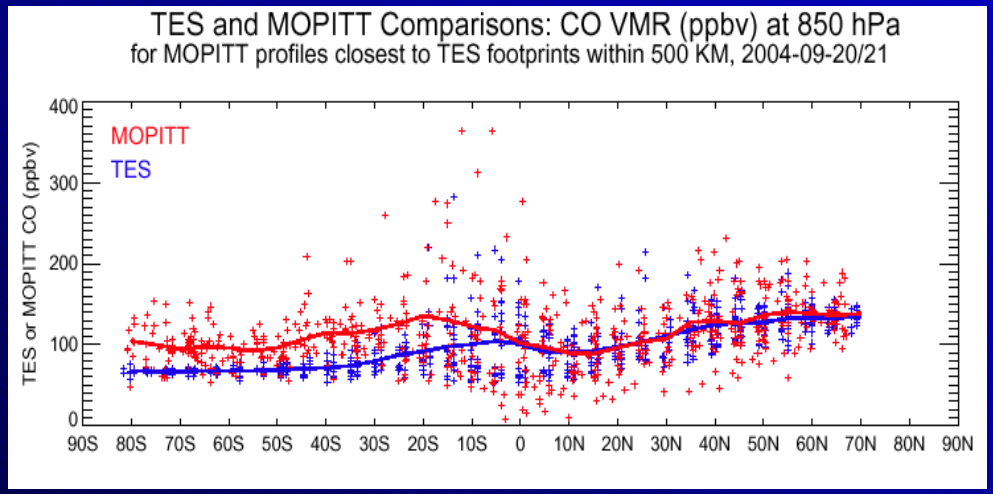
- Large oscillations
- Some negative CO volume mixing ratios
- Enhanced CO in winter polar lower stratosphere, due to not including HNO_3 lines

TES vs MLS - MLS CO Upper trop. VMR are higher than TES at low latitudes and lower than TES at high latitudes.

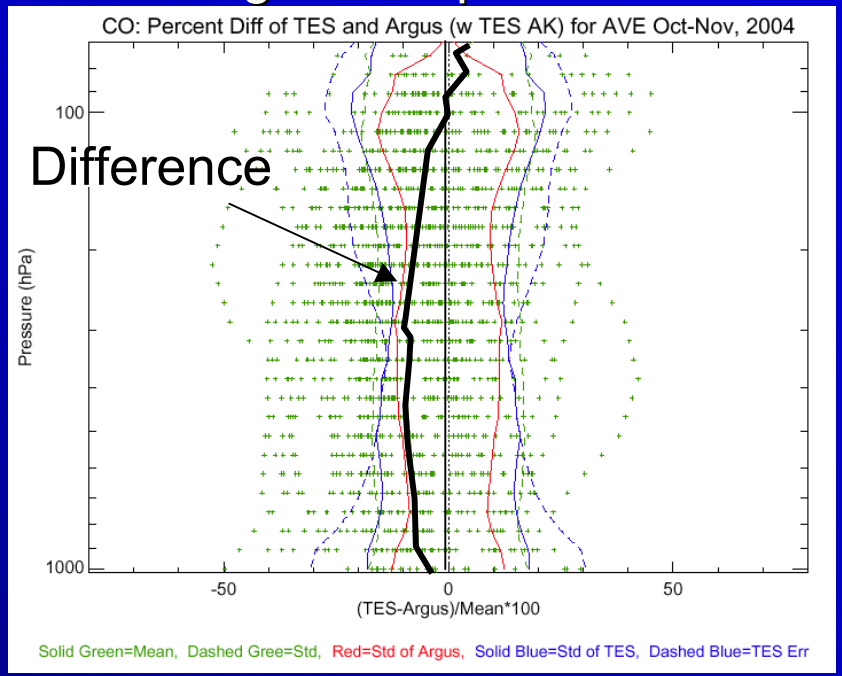
CO

- TES

TES and MOPITT



Argus Comparisons



CO Comparison with MOPITT and Argus show some bias

- Generally the agreement is not too bad
- A priori can have a huge influence on the profile if the averaging kernals are similar to each other (e.g no information in the radiances for isothermal profile)
- Improved CO should come from changing the optical bench temperature (improves the alignment) in TES - this will take place in November

What we have learned so far..

Validation activities have clearly shown where Aura data is useful for science. From the instrument side:

- MLS
  - Spectroscopic issues need work (interfering gases)
  - Algorithm (S/N) issues have shown up (e.g. CO)
- TES
  - Calibration issues - will be significantly improved in V9
  - Comparisons with S-HIS show small translator velocity errors in TES
- OMI
  - Algorithm issues at high latitudes - mainly in DOAS products
  - Products which have low S/N are affected by stripping (i.e. OClO)
  - Assumed trace gas profiles in the lower troposphere affect column calculations need better a priori's
- HIRDLS
  - Intensive validation will start in '06

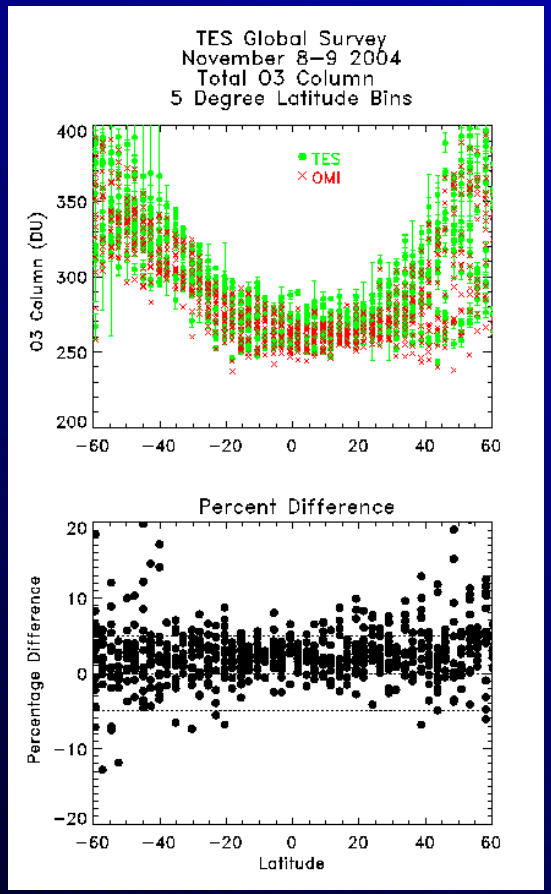
What we are looking for from INTEX

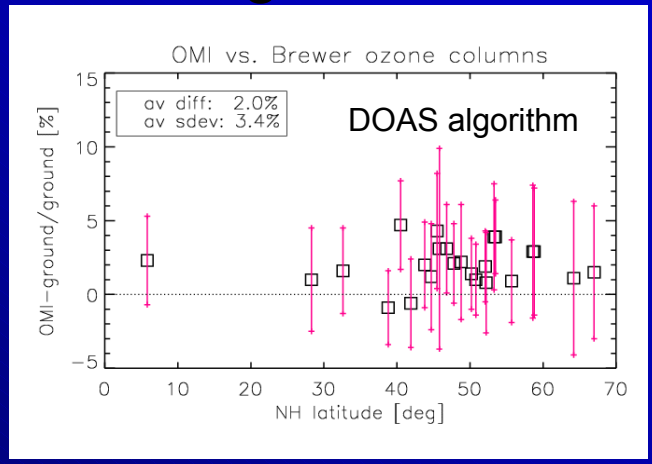
- Stratosphere and UT/LS O_3 and T for HIRDLS
  - INTEX flights should include night measurements along HIRDLS track (will also help MLS & TES)
- Tropospheric measurements for MLS, OMI & TES
  - Specific sub-satellite spirals (CO, T, H_2O, HNO_3, O_3, NO_2)
- Improved sonde coincidences (AVDC web tool + more active management)
  - HIRDLS and TES have a priority - look at who is closest to sonde site at overpass time - may be an hour apart.

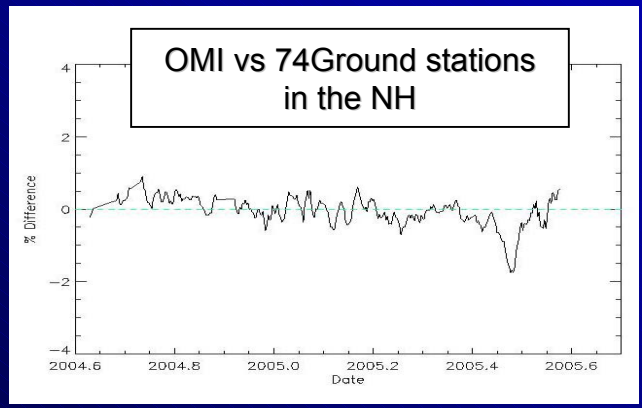
The End

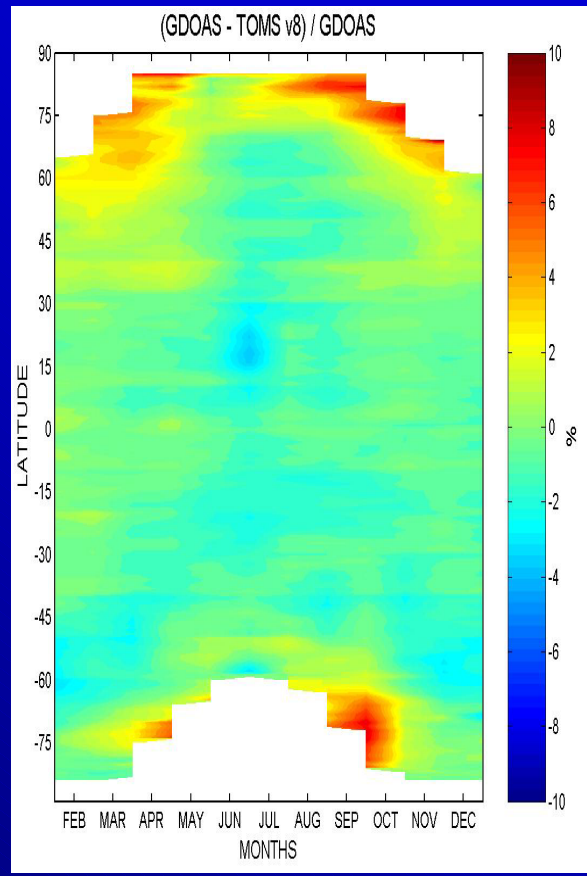
Ozone Column

- OMI TOMS and DOAS algorithms, TES column





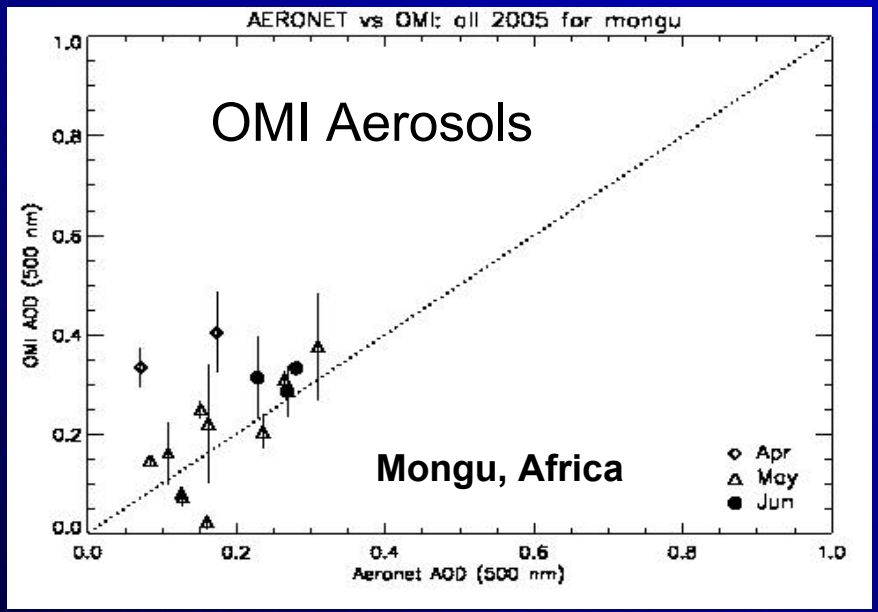


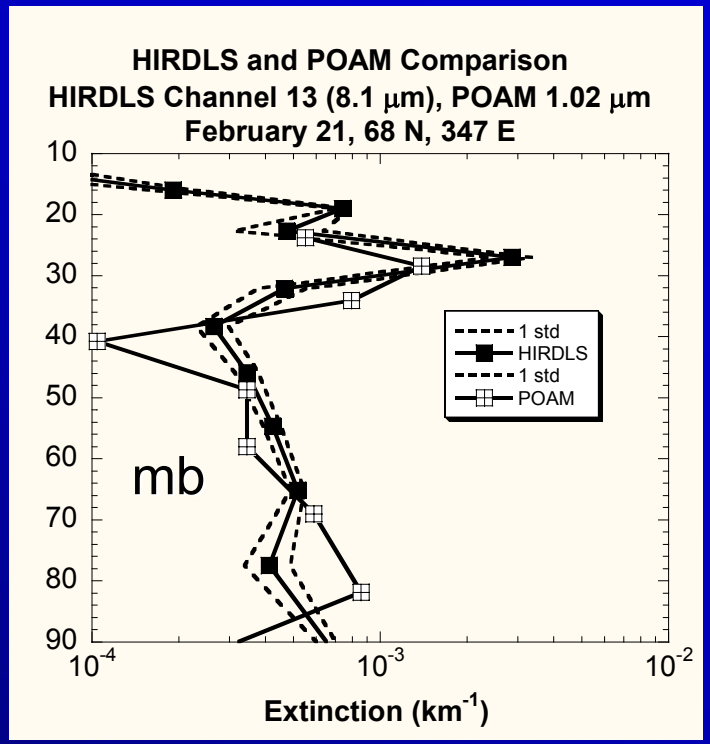


- No time drift in OMI, but DOAS vs TOMS bias show up at high latitudes.
- Good overall agreement between TES and OMI but some offset depending on clouds (probably due to assumptions about O3 below clouds).

Aerosols, Clouds and SO_2

- TES, OMI and MLS (Cloud ice)

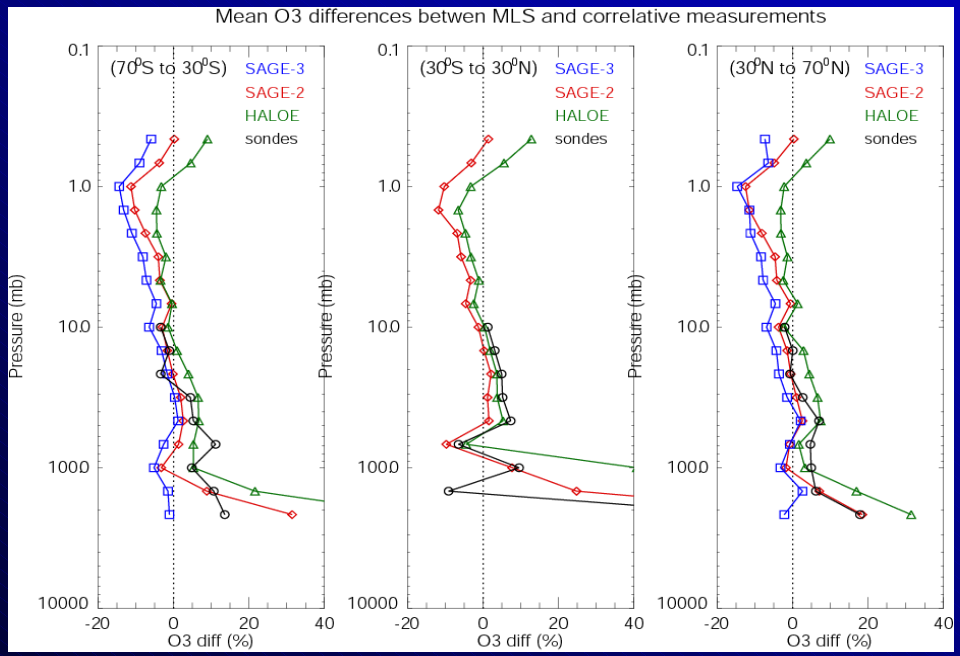


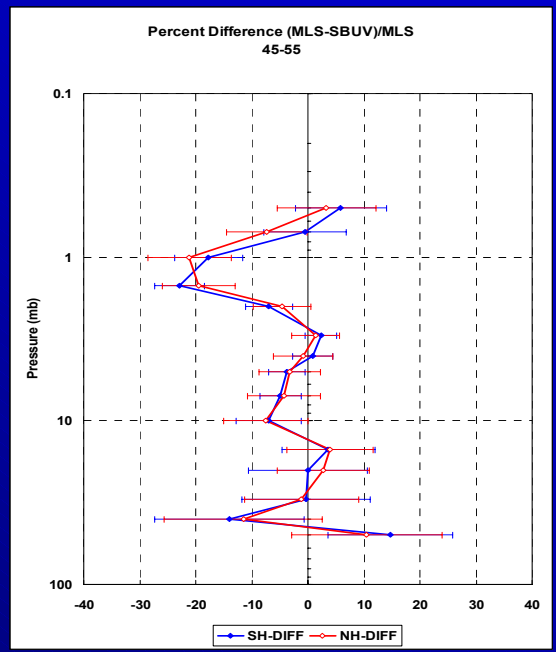


- MLS Cloud Ice has almost no validation
- OMI Aerosols are in good shape - comparisons to Aeronet
- HIRDLS aerosol product has had some preliminary comparisons
- TES vs MODIS cloud top pressure show some bias
- SO_2 needs more tropospheric (OMI) and stratospheric (MLS) validation

Stratospheric Ozone Profiles

- Most validation is associated with MLS
- HIRDLS is coming on line and will be the focus of sondes and stratospheric lidar profiles in ‘06





MLS Stratospheric Ozone

- A small slope in differences vs height exists but varies between data sets
- MLS lower limit is 215 mb with upper limit of 0.46 mb for now
- Need to investigate bias - could be spectroscopy; for slope could be pointing
- Larger issues in the UT/LS ozone - has team priority